CLAIMS

1. A method for producing a silicon ingot, the method comprising:

withdrawing a seed crystal from a melt comprising an amount of melted silicon in a crucible to form the silicon ingot, the crucible enclosed in a vacuum chamber containing a cusped magnetic field; and

regulating at least one process parameter, wherein the at least one process parameter is regulated in at least two stages, the at least two stages comprising:

a first stage corresponding to formation of the silicon ingot up to an intermediate ingot length; and

a second stage corresponding to formation of the silicon ingot from the intermediate ingot length to the total ingot length;

wherein regulating the at least one process parameter during the second stage comprises reducing a crystal rotation rate relative to the crystal rotation rate during the first stage.

2. The method of claim 1, wherein regulating the at least one process parameter comprises regulating the crystal rotation rate ranges between 8 rpm to 14 rpm during the first stage and regulating the crystal rotation rate ranges between 6 rpm to 8 rpm during the second stage.

3. The method of claim 1, wherein:

regulating the at least one process parameter comprises regulating the crystal rotation rate to 12 rpm during the first stage; and

regulating the at least one process parameter during the second stage comprises:

decreasing the crystal rotation rate over time from 12 rpm at the end of the first stage to 8 rpm when the silicon ingot length reaches 950 mm; and

maintaining the crystal rotation rate at 8 rpm during formation of the silicon ingot between the intermediate ingot length of 950 mm and the total ingot length.

4. A crystal growing system for producing a silicon ingot, the system comprising

a vacuum chamber;

a crucible disposed within the vacuum chamber, the crucible rotatable about an axis of symmetry, and configured to hold a melt including molten silicon;

a pull shaft movable along the axis of symmetry and rotatable about the axis of symmetry, and configured to hold a seed crystal;

at least one magnet to generate a controllable cusped magnetic field within the crucible;

a control unit comprising a processor and a memory, the memory storing instruction that, when executed by the processor, cause the processor to:

withdraw the seed crystal from a melt in the crucible to form the silicon ingot; and

regulate at least one process parameter, wherein the at least one process parameter is regulated in at least two stages, the at least two stages comprising:

a first stage corresponding to formation of the silicon ingot up to an intermediate ingot length; and

a second stage corresponding to formation of the silicon ingot from the intermediate ingot length to the total ingot length;

wherein the instruction, when executed by the processor, cause the processor to regulate the at least one process parameter by reducing a crystal rotation rate relative to the crystal rotation rate during the first stage.

5. The system of claim 4, wherein the memory stores instruction that, when executed by the processor, cause the processor to regulate the at least one process parameter by regulating the crystal rotation rate ranges between 8 rpm to 14 rpm during the first stage and regulating the crystal rotation rate ranges between 6 rpm to 8 rpm during the second stage.

6. The system of claim 4, wherein the memory stores instruction that, when executed by the processor, cause the processor to regulate the at least one process parameter by:

regulating the crystal rotation rate to 12 rpm during the first stage; and

decreasing the crystal rotation rate over time from 12 rpm at the end of the first stage to 8 rpm when the silicon ingot length reaches 950 mm; and

maintaining the crystal rotation rate at 8 rpm during formation of the silicon ingot between the

intermediate ingot length of 950 mm and the total ingot length.